High . . .

Tension

Electric

Storage

Company

Batteries

Front View of the Company's Works.

High Tension Electric Storage Co.,

Owner and Manufacturer.

— FOR THE —

United States,

—OF THE—

High Tension Storage Battery,

UNDER THE

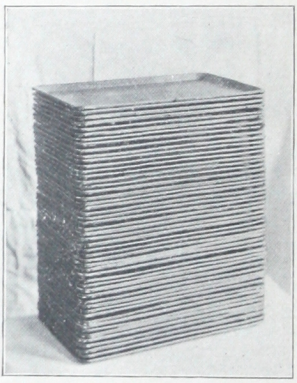
Edgerton Patents,

819-20-21-22 Heed Building,

Philadelphia, Pa.

Works: Souderton, Pa.

N. H. EDGERTON, President.
DR. JOS. H. WILSON, Vice President.
A. M. GEISINGER, Secretary.
J. K. CLEMMER, Treasurer.
J. B. ALDERFER, General Manager.



100 Volt, 35 Ampere Pile.

W F. GOETTLER, PRINTER,
SOUDERTON, PA.

General Information.

A Storage Battery is, broadly speaking, a reservoir of electrical energy. This reservoir is filled by connecting it up properly with a primary source of electricity, such as a dynamo machine or chemical battery. The current, or energy, from this primary source entering the battery, or accumulator, separates the electrolyte into its component gases, which are taken up and held by their respective electrodes. Their tendency to reunite, however, is not overcome, and the moment the opportunity is given by completing the circuit between them, they rush together, giving rise to an electric current flowing in the opposite direction. This is called *discharging* the battery.

Of course, the battery must be charged before it can be discharged; and, of course, no more can be drawn from it than was previously put into it. These operations, viz.: receiving and retaining the energy, and again imparting it, constitute the normal functions of the storage battery, and there is no other device known to science which can so successfully and conveniently accomplish this object.

The storage battery, as heretofore known, consisted essentially, of two electrodes immersed in an electrolyte composed of sulphuric acid and water. The two electrodes are formed of metallic lead and so situated in the acid bath that metallic contact between them is impossible, and these plates are then brought into an electric circuit whereby one is charged positively and the other negatively. This battery was invented by M. Gaston Planté, and is the prototype of our usual form of storage battery. The electromotive force of this element or pile is two (2) volts on closed circuit. The inventions of Faure, Brush and Julien are improvements upon the original Planté battery. The High Tension Battery is an adaptation of the old Voltaic pile whereby the principle of Volta is used as the foundation of a system of electric storage.

But in these batteries the zinc plate of the Volta pile is replaced by a layer of peroxide of lead, or other suitable oxygen, absorbing material on the one side of a lead plate and the copper surface by a layer of spongy lead or other hydrogen, absorbing material on the other, and the High Tension Battery is, therefore, the analogue of the Volta pile, without a single feature of the Planté type of batteries.

The working conditions of the Planté type of storage batteries are *immersion* by pairs, (one all positive and the other all negative), in an electrolyte, with a pressure of two volts, or one volt to each plate, and *either plate by itself absolutely useless*. The High Tension Battery, on the contrary, in its simplest form, consists of a single plate coated on each side in the manner just described, the one *side* being charged *positively* and the reverse *side, negatively*. The one plate thus holding and developing two volts in the circuit formed by connecting the outer surface of the positive with the outer surface of the negative side.

This peculiarity is the cause of the battery being named "High Tension," because the pressure per plate is just double that of the plates in the Planté cell. The simplest working conditions of this battery are *a single plate; no free electrolyte*, and a pressure of two volts. This single plate is the element or unit. It is obvious that the assembling of such plates can go on indefinitely, or until the pressure desired for any specific purpose is reached.

In operation, the current, in charging, is admitted at the first, or positive plate, and passes serially through each succeeding plate to the last or negative plate, thus utilizing the whole mass of the battery as an interior main or circuit, in a manner analagous to that of the liquid electrolyte in an ordinary acid primary battery. It follows, therefore, that from plate to plate, as well as from side to side of each plate the pressure is two volts. It also follows, that as the whole surface of the positive side of the plate is thoroughly covered with the peroxide, is not exposed to the erosion and disintegration caused by the evolution of nascent oxygen upon the metal plate as in the usual form of storage battery, which is the principle cause of their great cost of maintenance. Again, as the back of each plate is covered with porous lead in an atmosphere of hydrogen, it is reasonable to infer that

the life of a lead plate so situated should be very greatly extended. This inference is confirmed by practical test. *A battery having been taken apart after eighteen months continuous use, disclosed the fact, that so far as the eye could determine, no change whatever had taken place in the lead plate.*

The following copy of a report of tests of these batteries made for the "Franklin Institute," and under the direction of Professor Arthur J. Rowland, of the "Drexel Institute," will more fully describe the High Tension Battery.

"The following report is the result of a series of tests taken at different intervals during the past month, together with the data and curves compiled therefrom :

"The Accumulator placed at my disposal by you consisted of thirteen (13) full, and two (2) half plates laid in a pile. Sulphuric Acid of about 1,250 specific gravity, or 30 per cent. Baume is supplied to the edges of the plates and taken up by an absorbing material, that is not affected by the electrolytic action of the Acid and current, separating the peroxide, or positive element, and the monoxide, or negative element. The metallic conductor between the elements is a piece of thin sheet lead, aggregating 144 square inches of active surface carefully insulated on the edges to prevent the electric fluid from creeping around to the other side of the plate ; thus keeping the connection continuous throughout the pile and preventing leaks.

The Accumulator may be said to be fourteen (14) cells, arranged in series with three sides solidly cemented together, and the whole enclosed in a substantial box to prevent the buckling of the plates and acting as well for a protection against external injury due to rough usage.

The special feature of your battery is its construction, consisting, as it does, of 2.15 pounds of red lead, in the dry state, spread on one side of each plate, and 1.71 pounds of litharge, in the dry state, on the opposite side. The sheet lead used weighed about 60 pounds, and the remaining portion of 196 pounds was taken up by the absorbing material, acid, cement and the supporting box.

Another very distinctive feature from other Accumulators is that between this lead sheet and the monoxide on the one hand, and the peroxide on the other, there appears a potential difference

that divides up the 2.3 volts in about the ratio of their respective values to the cell.

I was informed by you that the normal charging rate for the battery was 50 milamperes per square inch, and the maximum rate 140 milamperes per square inch. Also that the normal discharging rate was 35 milamperes per square inch, with a maximum of 140 milamperes per square inch for periods of short duration.

Five tests were then made with the battery within these limits and E. M. F. for each element of 2.3 for a maximum and 1.8 for a minimum value on open circuit. Two on a normal discharge from which a quantity efficiency of 80.6 per cent. and 97 per cent., and an energy efficiency of 63.4 per cent. and 73.2 per cent. respectively were obtained. It was noted that in the first case the resistance of some of the plates was quite high, probably due to the lack of moisture between the plates. Two tests were also made with a charging and discharging rate of 83 milamperes per square inch. The Curves attached to this report will show you the gradual drop in potential as the discharge was continued, and in Curve "B" for discharge and charge "2" you will notice the high values in the E. M. F. when charge was resumed after standing several hours.

The fifth test was made with the battery standing on open circuit for a period of a week, during which time the drop of potential, from 31 volts was 2.5 volts; this fall of potential being greatest among those plates whose resistance was highest during discharging. The resistance of the Cell was about .38 of an Ohm when nearly charged, and varied from this up to one (1) Ohm as the battery was discharged; that of each element varying from .018 to .135 of an Ohm. In summing up I should say that the construction of your battery seems particularly well adapted for the "forming" of the peroxide and monoxide placed as they are in such a position and sufficiently close together to absorb the oxygen and hydrogen readily, as they are set free by the electrolytic action; the thin sheet lead acting as an electrode as well as the conductor between the different elements.

Respectfully,

(Signed) A. H. MASTERS,

4th mo., 8th, 1897. Drexel Institute Laboratory.

The following letters add testimony to the durability and effectiveness of the High Tension Batteries:

Compton Manhattan Automatic Control Co.,

NEW YORK, August 4th, 1897.

HIGH TENSION ELECTRIC STORAGE CO.,
1227 and 1229 Callowhill Street, Philadelphia, Pa.

Gentlemen:—In reply to your inquiry of recent date we are pleased to say that the Storage Batteries which we have installed in different cities, of your make, have given the best of satisfaction. We do not hesitate to say that wherever we are required to use Storage Batteries in connection with our system yours will be adopted. The small amount of space required to secure necessary voltage, together with its efficiency should commend it to all.

Yours truly,
COMPTON MANHATTAN AUTOMATIC CONTROL CO.
(Signed) M. D. COMPTON, PRES'T.

PHILADELPHIA, August 3rd, 1897.

This certifies that I have used a Holt Storage Battery in my office continuously for the past four years, during which time it has given me complete satisfaction as a generator of motor power, electric light and cautery.

I make this statement after having tried other Storage Batteries and found them unsatisfactory.

(Signed) ELLWOOD MATLACK, M. D.
No. 843 North Broad Street.

(Note. The Holt Storage Battery to which reference is made above is that now known as the High Tension Battery.)

F. S. Newman, Architect and Designer, Constructing Engineer.

PHILADELPHIA, July 24th, 1897.

HIGH TENSION ELECTRIC STORAGE CO.,
Nos. 1227 and 1229 Callowhill Street, Philadelphia, Pa.

Gentlemen:—The Storage Battery you installed for us in the Fidelity Mutual Life Association Building, 112-116 North Broad

Street, Philadelphia, Pa., has done its work in a very satisfactory way. I am so well pleased with your battery that I shall in future have it installed wherever I may need the use of a Storage Battery.

Respectfully Yours,

(Signed) F. S. NEWMAN,

U. S. A. Architect.

PHILADELPHIA, September 15th, 1895.

PROF. N. H. EDGERTON, SEC.,

Holt Electric Storage Co., Philadelphia, Pa.

Dear Sir :—We have one of your 28 volt batteries normal intended for dental use in hand since last February. Most of this time it has been used on standing test to see what drop in potential would amount to in given period. The test showed that this battery of about one-fourth kilowatt capacity with a use of 25 per cent. of its energy dropped three volts in sixty days. We consider this result remarkable taking into consideration the high E. M. F. of the battery in connection with its comparatively small capacity.

We have at the present time one in use which shows even a better result than the foregoing. *It has stood for three weeks without any appreciable drop whatever.*

We consider this test conclusive and have decided to adopt your battery for use with all our appliances.

Very truly yours,

(Signed) LOUIS COSTA, JR., & CO.

MANAYUNK, PHILAD'A., October 23rd, 1897.

HIGH TENSION ELECTRIC STORAGE CO.,

1227–29 Callowhill Street, Philadelphia, Pa.

Gentlemen :—The system of Electric Storage Batteries that you have placed in our factory, and which we use for lighting in dark rooms of our warehouse, is working quite satisfactory, and

we would not like to do without it, and would cheerfully recommend it to all those interested in the use of Storage Batteries.

Yours respectfully,

JAMES STAFFORD'S SONS,

Manufacturers of Woolen Goods, Blankets, &c.

The following is copied from the issue of the *Souderton Independent*, Friday, July 30th, 1897: "The electric light plant in the *Independent* building is now completed and the system has twenty-one sixteen candle power incandescent lights. This system of lighting is by storage battery and is the first electric light plant in town. Our battery is capable of running ten lights ten hours when fully charged. We however will not average over eighty lamp hours a week, and being able to fill the battery to that extent in about twenty hours' run in connection with our printing presses, thus doing our printing and generating the electricity at one and the same time with practically no additional expense for lighting our printing establishment, society room one evening every week, and the dwelling. The system is without doubt just the thing for lighting any building where power is used to propel other machinery, be it on a small or extensive scale. The electricity in our plant is generated with a one-horse power dynamo, and we are able to run our large cylinder press, paper folder and dynamo at one time with a 3½ horse power Otto gasoline engine at an expense of four cents an hour. We invite public inspection and will cheerfully give all the information concerning our plant possible."

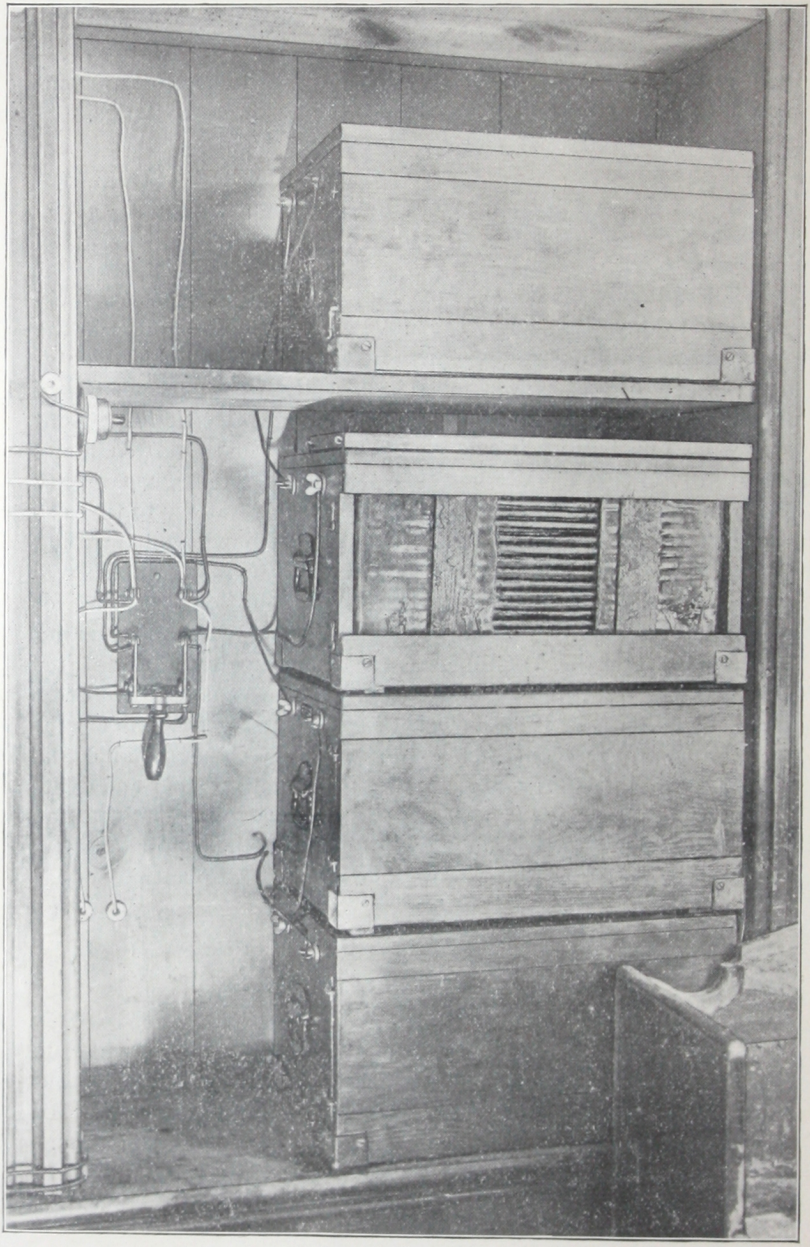
SOUDERTON, PA., May 2nd, 1898.

HIGH TENSION ELECTRIC STORAGE COMPANY.

Gentlemen:—Our Electric Light plant was introduced in July 1897, and we have done our printing and lighting our establishment the past nine months at an average expense of $1.20 a week. The average run was just 2½ days a week and we have worked until ten o'clock five evenings every week the past four months.

Yours Respectfully,

W. F. GŒTTLER.



The above represents the installation of High Tension Batteries referred to in the foregoing extract from Souderton Independent.

Practical Uses of the High Tension Storage Battery.

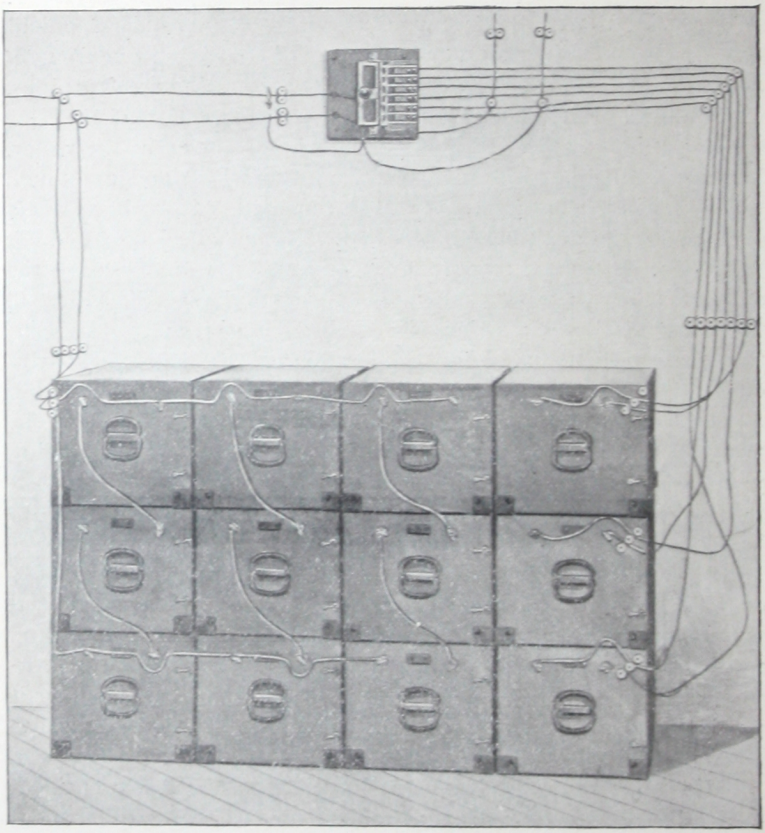
A prominent English writer has recently said (Encyclopedia Brittannica, Supplement 1890,) "Hitherto these sells have not been durable. When they are perfected in that particular they will be most valuable adjuncts to many electric enterprises."

One of the largest Waterwheel Manufacturing Companies of the world says in regard to the High Tension Batteries (letter, August 3rd, 1897,) "There would seem to be a considerable field for an accumulator or storage apparatus of that kind, *and it ought to form a part of the regulation of the Turbine.* Where Turbines, or Cascades, are used under considerable heads, a part of the time the wheel is not receiving the full benefit of power in the water, because it must be either deflected from the wheel and not touch it at all, or in part, at least, or must be throttled. In both instances there is a large amount of power lost. If the wheel could be left full open, so that a storage or accumulator would receive the surplus, when there was too much power and give off a part of the accumulation when there is too little power, and thus utilize the highest economy of the water and at the same time partly effect the regulation ; it would be the means of solving that kind of problem in many instances." Another says: "We shall be very glad to co-operate with you in the matter of introducing your High Tension Batteries, and will refer to you any propositions which may come to our notice in which we think your battery can be used to advantage."

Every *Dynamo* wherever installed, or for whatever service employed, should have a system of High Tension Storage connected with it because among many reasons—it is *economical*, and results in saving from one-quarter to one-half the cost of fuel, service, wear and tear of engines, machinery, etc., and it makes it possible to utilize the full power of wind, water, or steam, used to generate the current.

It is an *insurance* as it is a guarantee against loss from accident to the dynamo, or its stoppage from any cause, with consequent loss of light or power. It is a *regulator of light or power* furnishing a reservoir from which power or light may be drawn and at

pressures far in excess of the capacity of the dynamo to give, and it is *inexpensive* in first cost. It requires practically no repairs and absolutely no expenditure for management. The dynamo which is used to charge the High Tension Batteries may itself be of a capacity as low as one-half horse power, or as high as desired. The gas, oil, or steam engine, the windmill, water motor, or any source of power may be used. Being an accumulator the dynamo may have the smallest power, yet by coupling the High Tension Batteries in series any desired power can be developed.



The above cut represents 12 Kilo Watt Batteries arranged with switch to charge and discharge by simply throwing switch, 180 16 candle power lamp hours.

The High Tension Storage Batteries are dry, portable, and attractive in appearance. They have no acid fumes to tarnish, nor to oxidize fixtures, plate, nor machinery ; and they have no acid contents to spill over and destroy furniture or carpets. They are of but one-third the size, one-third the weight and their first cost is less than one-half the first cost of any form of wet battery. Their subsequent cost of maintainance is practically nothing. The field of their use is almost as illimitable as the force of gravitation itself. They may be used for lighting the delicate lamp of the throat specialist, or for operating the ponderous machinery of large manufactories ; they may be used for lighting the carriage, or the bicycle, or for the lighting and propulsion of cars upon the land, or vessels upon the water.

Special Applications.

Among the useful and economical special applications of the High Tension Batteries are for :

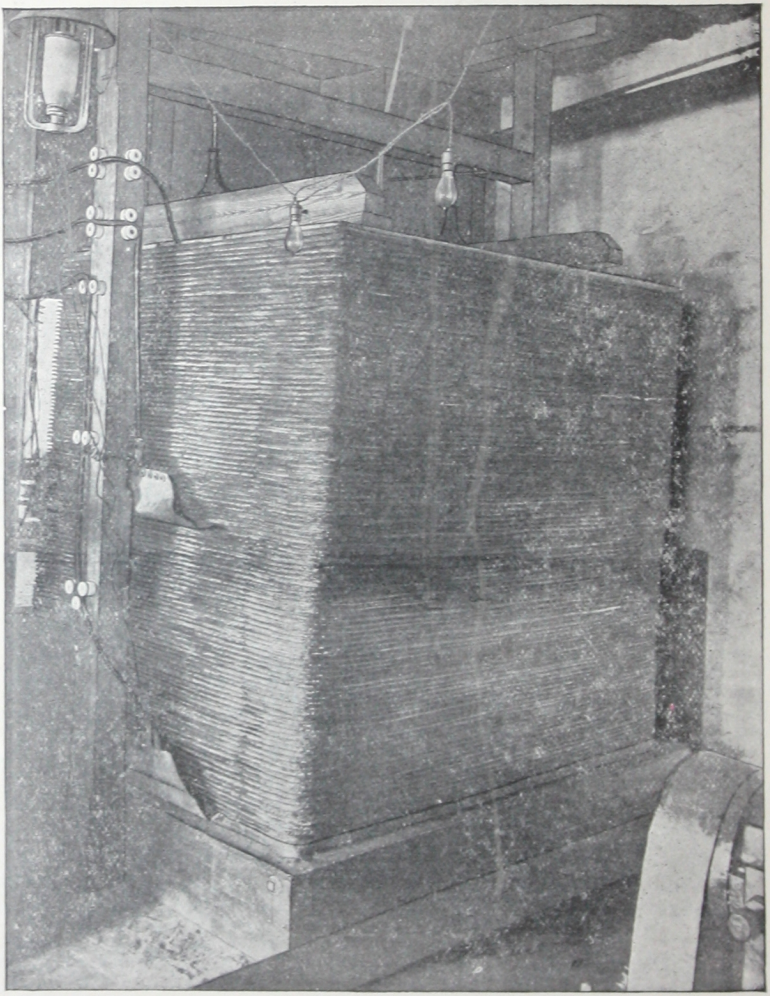
Reducing the cost of light or power in Central Electric Stations.
" " " " " " " " Railroads or Street Cars.
" " " " " " " " Horseless Vehicles.
" " " " " " " " Hotels, Office Buildings.
" " " " " " " " Large Stores, Manufactories
" " " " " " " " Mines, &c., &c., &c.

Their small size, portability and power make them especially fitted for use in Carriage and Bicycle lighting, and for the running of all classes of *Motors*, as *Fan*, *Sewing Machine*, *&c.* They are particularly well adapted for use in *Telegraph*, *Telephone*, *Burglar* or *Fire Alarm Service ;* for *Automatic Organs*, or *Musical Instruments*, *Thermostats*, *Phonographs*, *Kinemetographs*, *&c.*, or for *Surgical*, *Dental*, *Medical*, *Chemical*, *Laboratory Work*, *&c.*

The High Tension Battery may be charged by any direct current of electricity, whether arc or incandescent.

If the charging current be created by a Dynamo run by a windmill, or by water power the cost of the electrical power or light furnished by the High Tension Storage Battery system is reduced to interest only upon the first cost of the plant there being no service required in their maintainance.

A good form for the eqipment of Electric Light and Power Stations is shown in the accompanying cut, which is from a photograph of the large battery in the works at Souderton. Such a battery furnishes a maximum of power with a minimum of space and cost ; the one illustrated having plates 6x7 feet and being 7 feet in height, and is composed of 110 plates. This cubical mass takes up but a small corner of the engine room and yet has a storage capacity of over 60 horse power for 10 hours.



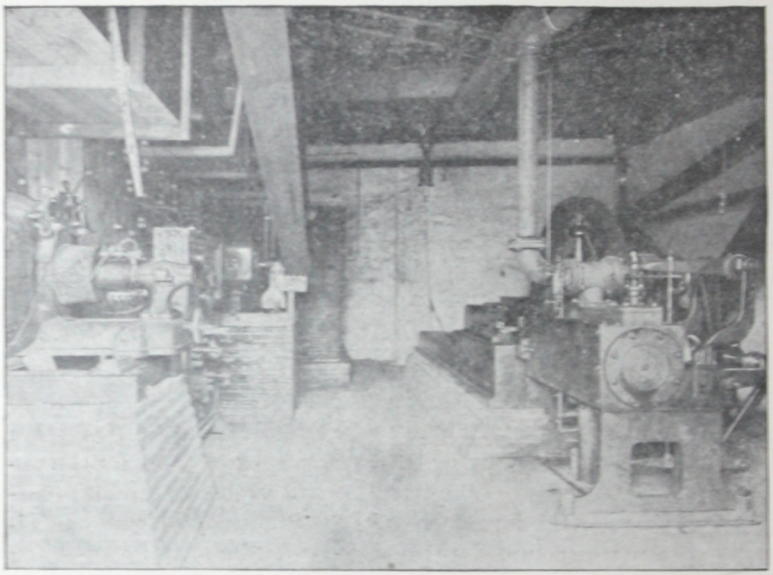
Some Suggestions of Application of the High Tension Storage Battery.

Where the engine is run during the day as in manufactories, large stores, hotels, office buildings, etc., there are always periods when the power not being otherwise used or needed may be turned on to a system of High Tension Batteries which will furnish without cost all the light needed for the hours when it is required. For this work, the batteries are arranged in groups to charge evenly with the lamps run directly by the dynamo. When that is shut off, by the use of a proper switch, the battery is thrown into other groups arranged to deliver the same voltage or pressure to the lamps which they had when fed directly from the dynamo. For this work, four cells will furnish current for five 110 volt, 16 candle power, lamps 12 hours.

Through this application of the High Tension Storage Battery the coal and service bills of any manufactory, hotel, office buildings, etc., etc., may be very materially reduced.

In Electric Light and Power Stations, the plant usually has all that it can do to supply its customers for the three hours of greatest demand, say from seven to ten p. m.—for another three hours it is running at a greatly reduced rate of income—for six hours more at a rate only equalling expenditures and for the remaining twelve hours of the twenty four earning nothing at all—in all such cases the introduction of the Storage Battery in sufficient quantity to accommodate the *over-production* at full load—from 5 30 to 7 p. m., and again from 10 to 12 midnight, and store it for use from midnight until daylight next morning, saving fuel and wages for at least six hours—will go far toward making a struggling lighting plant a successful one, or to increase the profit of any existing plant—which is now wasting more value in fuel and services annually than would fully equip it with the High Tension Battery System. It would be, comparably, as good business practice to attach the gas retort pipes directly to the delivery mains, as to try to supply customers with electric current from the dynamo only. Both can be accomplished, but they can be done so much easier and better with the reservoirs that it is superlatively foolish to do without them.

For the Lighting or Propulsion of Street Cars, the reduced weight and size and their freedom from offensive liquid contents make the High Tension Batteries peculiarly well fitted for the lighting and propulsion of Street Cars, Horseless Carriages, &c., upon the land or of Vessels, Yachts, Launches, Gunner's Skiff's, &c., &c., upon the water.



Engine Room containing Engine, Three Dynamos, Pump and Battery.

For the Running of Street Cars they may stand in the power-house ready at all times for instant use in case of accident to the dynamo and such accidents have not been infrequent from which whole lines of cars have been stopped out on the track without power or light for hours. They may be placed along the line to serve as boosters for difficult places, or set in the car itself for crossing spaces where trolley wires are inadmissable ; or to avoid the delay to travel caused by the breaking of the trolley wire—each car being under such circumstances capable of individual propulsion. From this condition to that of doing away with the

trolley wire altogether is but a step by which each car becomes independent of the power house supply. Unsightly poles, dangerous currents and overhanging wires are avoided. Not only the risks of fires and loss of life are greatly lessened, but the substitution of the High Tension reservoirs will result in large economy to the operating companies who are now obliged to keep up a large steam power for many hours of each day when they have no immediate use for it and which being transmitted through the dynamos to the High Tension Batteries will result in obtaining effective power from every pound of coal consumed.

Electric Launch.

Sea Going Vessels or Other Boats. Much the same economy may be attained by the use of the High Tension Batteries on all *Sea Going Vessels* whether propelled by steam or sail as noted above. When the dynamo is shut down at about 10.30 p. m., as in steamships, the lighting of the engine and boiler rooms is absolutely essential to the safe and speedy handling of the vessel—the now wasted power of the dynamo during part of each day stored in the batteries costs nothing and adds much to convenience and safety. The sailing vessel needs it to keep up her lights and for hoisting and taking in sail ; for operating launches, pleasure boats, gunners' skiffs, etc., this battery is unequalled, both on account of its lightness, compactness and freedom from slopping. If there

be no dynamo aboard the boat or in the boathouse, the ready portability of the batteries insures ability to recharge them at any source of current.

For Lighting up Railroad Tracks in advance of Moving Trains. This may be accomplished by the installation of the High Tension Batteries at a first cost and expense of subsequent maintainance which would be many times repaid in the avoidance of one accident which might be charged to an inefficiently lighted piece of road. We will only outline the manner in which it may be done with comparatively small expense. The outfit would include a small coal-oil engine, a small dynamo for producing and a small Storage Battery for retaining the current, which is automatically shunted on to the lamps ahead of the train as it enters each block, and off from them as the train passes to the next block.

For Underground Mining. The High Tension Battery is particularly adapted to afford a ready portable supply of light or power. Electricity is now used in more than 300 mines in the United States and the proprietors of as many others are considering its utilization. Electricity tried under the arduous conditions of mining service has been shown to be peculiarly efficient, safe and reliable. It presents a system of the greatest simplicity, completeness and flexibility, permitting power to be distributed in units of any size and for any purpose. With it there is neither heat, friction nor condensation. It does not vitiate the air and the incandescent lamp can give rise to no explosion of fire damp. With a dynamo on the surface the portable High Tension Batteries may be carried charged into the remotest drifts of the workings—they may be used there to run the drills, fire the blast, light the breast, signal the surface, or do any of the thousand and one things which may be required of them and the cost of their service limited to the handling from the charging current to the place of its development or use.

The High Tension Storage Battery in connection with Water or Wind Power.

Notwithstanding enormous mineral wealth, richness of soil and variety of climate the scarcity of fuel or its high cost, has

largely hindered the development of many sections of our country and of the world, yet we find in the majority of such sections either ample water powers or an unlimited wind force fully sufficient to furnish the cheapest of all powers for manufacturing or lights. The State of North Carolina has for instance sufficient water power unemployed to spin three times the whole cotton crop of the United States, yet not over one-fourth of the crop is spun in this country annually. In the vast prairies of the Middle West there are no water powers but the unlimited wind power is more than sufficient to run all their factories or to light all their cities and homes. Ten years ago it was not considered practicable to use either of these powers at any distance from the water fall or the wind mill, to-day they are being transmitted by electric cables over distances which bring many hundred square miles within their radius ; 1,700 horse power transmitted from a water wheel system over 17 miles —the power for mines employing tens of thousands of men ; the 11,000 voltage delivered to the City of Fresno in California, at a distance of 35 miles from its source, are among the many effective examples of electrical transmission to-day, and among the many we find, some, testifying to a saving of more than $40,000 annually by the substitution of water power for fuel. All such electrical installations while showing an enormous proportion of increased economy are (as we see page 11) capable of improvement and their economical operation may be indefinitely promoted by the co-operation of the High Tension Battery System, not only as a regulator to the power itself or as an insurance in cases of accident to the power, but also from its flexibility permitting the use of any voltages from 30 to so many thousands, as may be desired for any particular work. In this connection it may be of interest to quote the following extract from a very elaborate and exhaustive report to the Secretary of the Navy regarding water power :

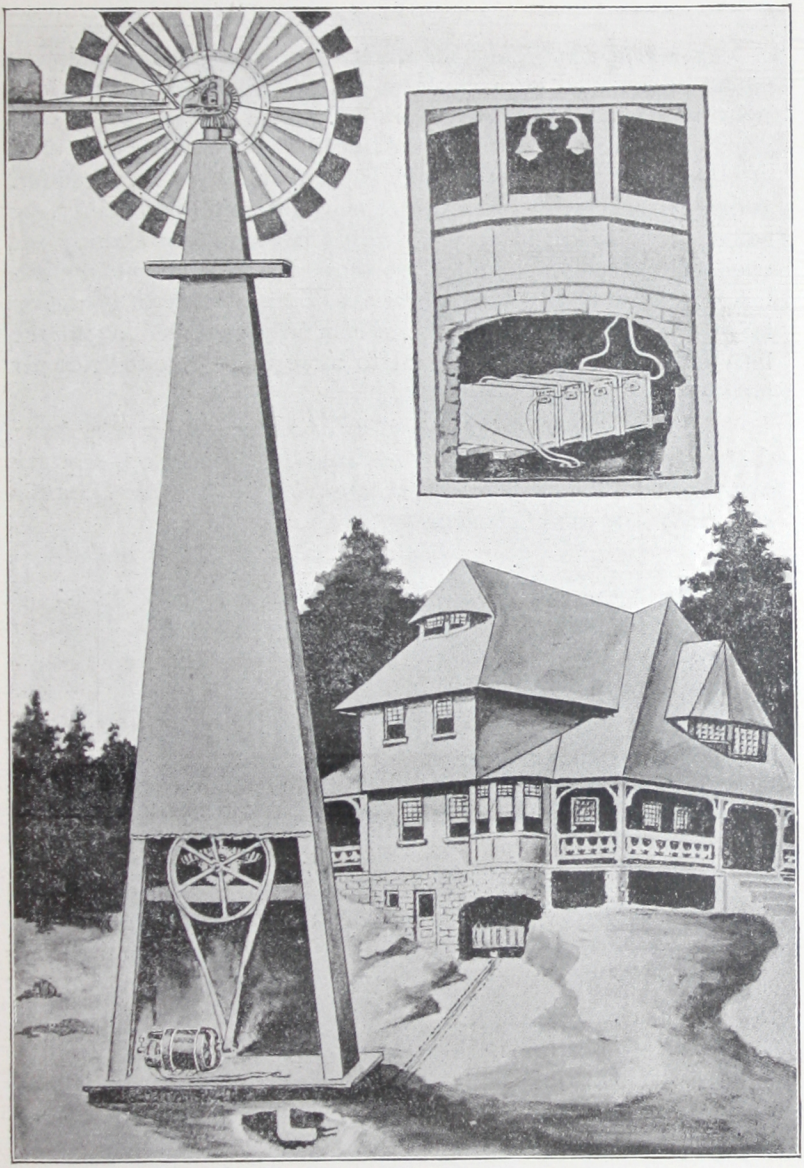
"A water motor has a wider range of power than any steam engine. It is simply a question of the amount of water that can be provided for it. With the same Pelton Wheel I have got 16 horse power at an efficiency of 86 per cent. and ¾ horse power at 82 per cent. efficiency. Where is there a steam engine that can equal that performance? This same motor is capable of developing at least 60 horse power at the same high efficiency."

(Signed) LIEUT. F. J. HAESELER, U. S. N.

An efficiency of 91 per cent. is reported by Prof. Reuleaux, of the Polytechnic School in Berlin. When an efficiency of 86 to 91 per cent. may be obtained from a power and re-delivered from the *High Tension Batteries* at 97 per cent. as shown in the report of tests on page 5, it would seem that the desired ultimatum of cheap power for general transmission had been reached through their use.

Windmill Power.

Scattered all over the country, but perhaps more particularly in the New England States, in the West and in Texas are thousands of windmills now used for pumping water, or sometimes geared to do certain farm work from turning the grindstone to cutting fodder and grinding corn. Many such mills furnish the power for drawing water to suburban residences without being geared to any other work. With the High Tension Battery as a reservoir for the otherwise waste power of these mills every farm house or suburban home may be supplied with an inexpensive supply of electric light and the farmer will have a reservoir from which to draw the power to run his machinery or to light his roadways. The energy which can be stored and utilized by these batteries in co-operation with a windmill is proved by consideration of the average velocities of the wind, to be far in excess of the supply necessary for the full electric illumination of any modern residence, and by automatic governors regulating both the speed of the dynamo and shutting off the current from the batteries when full, absolutely all attention or service is dispensed with in their operation.



Outfit for Suburban Home.

Four cells arranged to operate 50 volt 16 candle power lamps would be sufficient for many farm and suburban residences where from three to six lights are ordinarily used. The number of cells required in this case is due to the fact that the wind does not blow all the time, and extra storage capacity must be arranged for. Where water power is used two cells would, in all probability, be sufficient The cut illustrates clearly the manner of gearing the windmill to the dynamo, and also shows the connection to the battery. A plant of this kind where the mill is already in operation for other purposes will not cost, when fully equipped, a sum the interest of which would amount to more than $1.50 to $2.00 per month.

Such a cost for the electric lighting of a 16-roomed country house is less expensive than coal oil without counting the risk, and cases are on record with this company where the saving in insurance annually exceeds the first cost of the batteries.

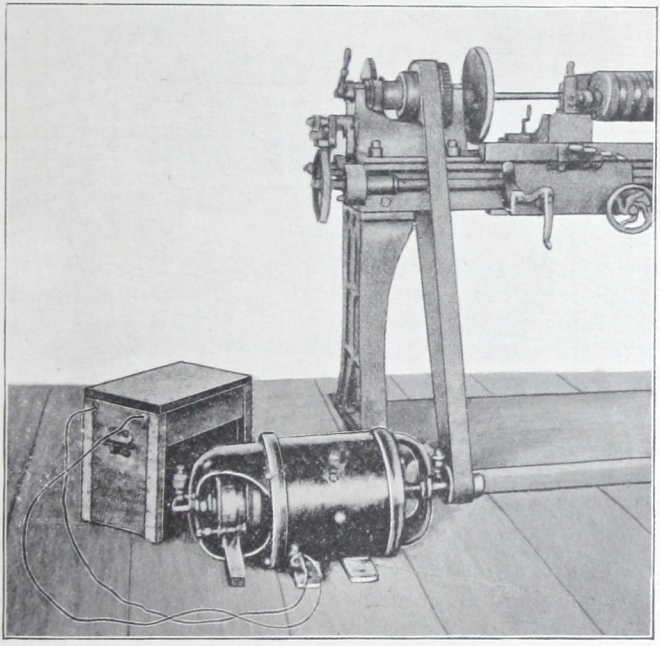
Where large permanent installations are made special sizes of battery cells may be made, suited to the particular exigencies of each case, and any voltage required may be provided for by coupling the cells in series. For all ordinary cases the company usually have in stock the following classified list of batteries, all of which are readily portable. Special cells put up in handsome polished antique oak boxes with handles at each end or on top for convenience in carrying about.

Classified List of Our No. 2, 28 Volt Batteries.

PRICES ON APPLICATION.

BATTERIES FOR GENERAL USES.

No. 1. 28 volts, 1 to 30 amperes, carefully mounted in wood boxes.



1 H. P. Battery and Motor, geared directly to Machine Lathe.

Batteries for Electric Lighting.

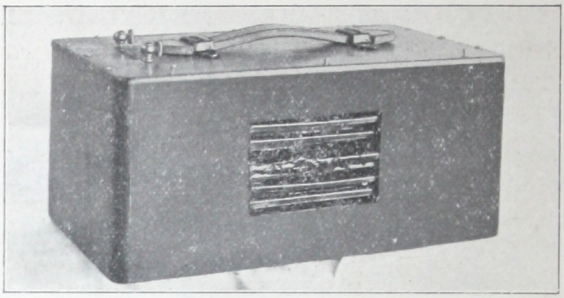
No. 2. One Battery (four boxes) 110 volts, 1 to 30 amperes discharge, capable of running *six* 110 volt lamps 10 hours. Mounted as above.

The above battery occupies a space of 46 in. long, 15 in. wide, and 11 in. high, while the following occupies multiplies of that space.

No. 3. One Battery (eight boxes) 110 volts, (in parallel) 1 to 60 amperes discharge, capable of running *ten* 110 volt lamps 12 hours. Mounted as above.

Our Standard Size Battery is double the ampere capacity, Same voltage and series as above.

Carriage Batteries.

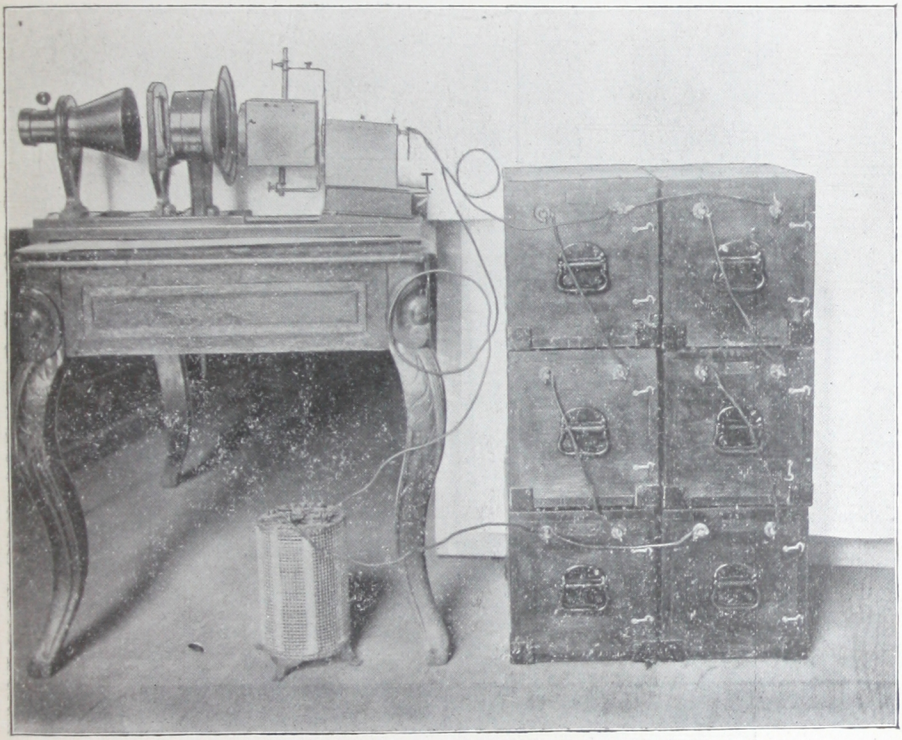


The above Battery for Carriage Lighting affords the means for always having attached clean, convenient, inodorous and certain lamps, which neither smoke nor break readily, and which wind nor rain have no power to extinguish.

Laboratory Batteries.

Our Laboratory battery is unique in its adaptability to all kinds of laboratory work, whether chemical or physical. The standard cell for this purpose has a normal pressure of 28 volts, with a density of current of 20 amperes. The battery is supplied with intermediate terminals, giving from 2 to 28 volts pressure, furnishing at once a battery for any range or character of work up to that of twenty-eight half gallon Bunsens. With these the disagreeable duties of cleaning, filling, &c., are avoided, as well as the casualities of short circuiting, boiling, slopping, &c., which every worker of batteries knows without enumerating. Then too, the space occupied is insignificant, and the appearance such that it does not have to be relegated to the cellar or the depths of the closet, but can be kept directly at hand, and always ready.

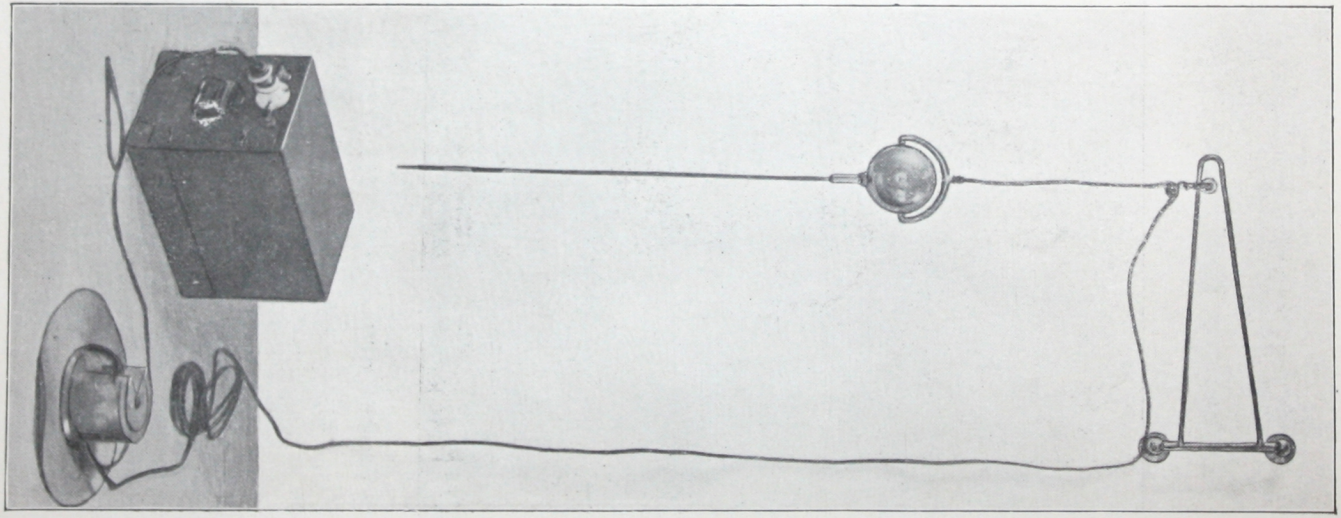
Battery for Projection.



High Tension Battery for Projection Work.

The Dental Battery.

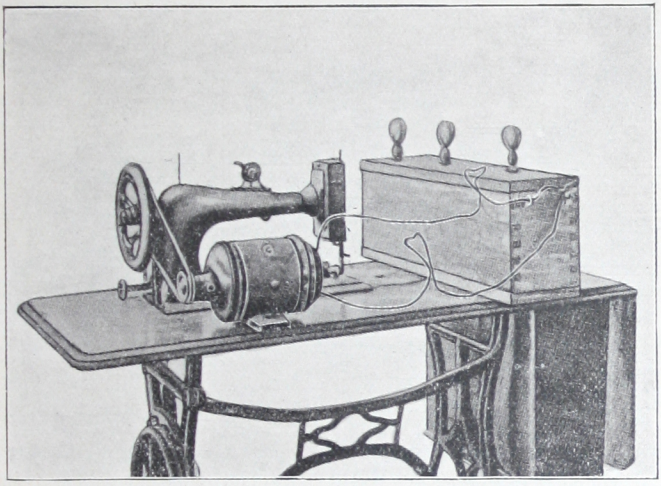
Is also fitted with intermediate terminals to allow of its being charged by gravity-primary, or other closed circuit batteries. This, while costing more at the outset, obviates the necessity of removing the battery for recharging, as they may remain coupled in, all the time keeping the reservoir always full.



Dental Outfit.

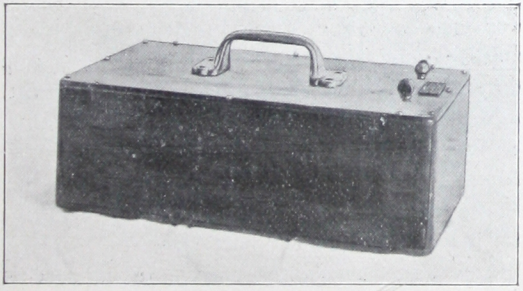
See letter on page 8 regarding this battery.

This battery is also admirably adapted for *sewing machines and other light machinery.*



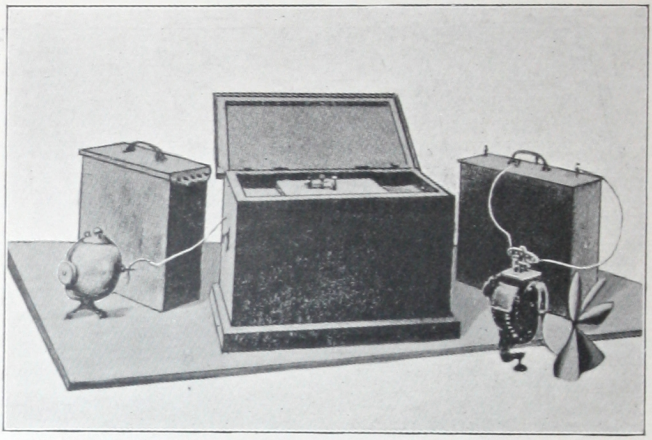
Sewing Machine Battery and Motor set on the table of the machine in cut, but can be placed in any other convenient place.

for Cautery, &c.



Our Cautery battery is standard at 8 volts and 15 ampere hours, either with intermediate terminals or rheostats. Mounted in oak. Larger or smaller sizes to order.

Therapeutic Batteries.



Left-hand fig., Dental Motor and Battery. Central fig., 100 volt Therapeutic Battery. Right-hand fig., Battery and Fan Motor for Sick-room.

The present age, full as it is of electrical energy, produces the grandest results to mankind in wonderful progress and improvement in the sciences and arts, but perhaps the noblest and best products of the age are those applied to the alleviation of human pain and suffering. In view of the late discovery by scientists that the blood may be ozonized, within the veins, by the use of a direct, constant, electrical current of high intensity applied externally to the person, it becomes desirable and important that physicians should have within their reach an ever-ready apparatus capable of producing such an effect, and more especially since the same instrument is useful for stimulating circulation, for vesication, and for the treatment of various comatose conditions. This will be found in our Therapeutic batteries.

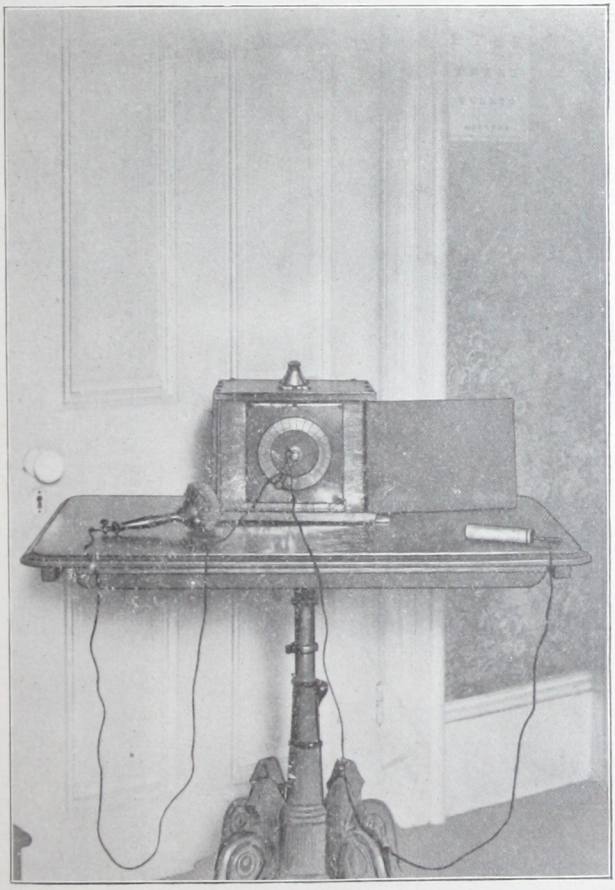
For all these purposes we are manufacturing Dry Storage Batteries of two capacities: one from 2 to 50 volts, and the other from 2 to 100 volts pressure. They are compact, portable and durable, and entirely free from any noxious or corroding vapors. There are no free acids or other liquids to spill, and no mechanism

susceptible of derangement. They are consequently always ready for use.

From 2 to 50 volts, with sliding contacts giving 2 volts increments.

From 2 to 100 volts, with sliding contacts giving 10 volt increments.

Medical Battery.



Extract from U. S. Supplement Encyclopedia Britannica.

"The quantity of electricity necessary to charge them to saturation marks their capacity. The quantity of electricity in a circuit is measured in Amperes per second, and the unit is called a Coulomb. A cell may require 500,000 Coulombs, or more to charge it; a dynamo that could give 25 amperes current would charge it in 500,000–25 seconds, or 20,000 seconds, or 5 1-2 hours. The time of discharge depends upon the resistance of the circuit. If discharged through a short, thick wire with such resistance as to admit a current of 25 amperes, it would only require the same time to discharge. It could maintain a current of 10 amperes for 14 hours; thus 500,000–10 seconds, or 50,000 seconds, or 14 hours; viz: providing there was no waste. The horse power of such a cell would be 2.25x10–746 or .03 of a horse power."

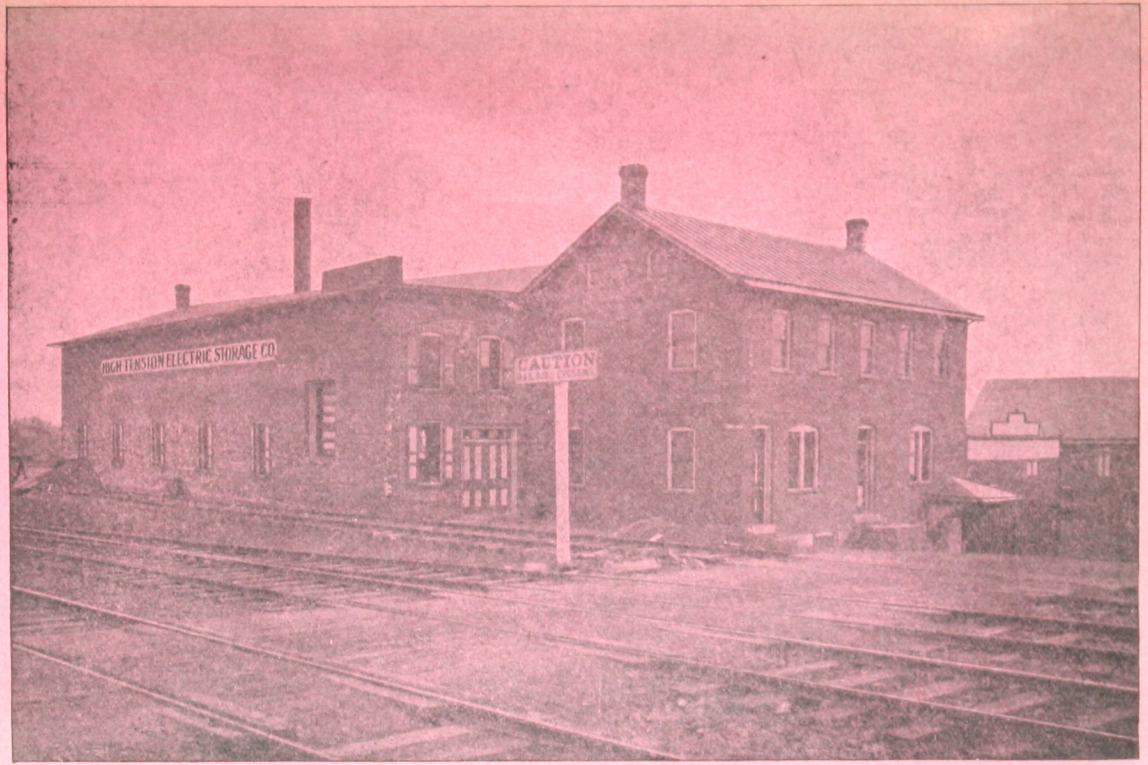
A No. 1 High Tension Battery has an amperage of 35 ampere hours, and a voltage of 30. A 1-2 horse power dynamo will charge such a cell to saturation in 2 2-3 hours. Four of these cells coupled together will then have a capacity of 4,000 Watt hours, or 5 1-3 horse power, and may be *discharged* in feeding 60 lamps of 110 volts each in *one* hour, or will last for supply of 5 such lamps for *twelve* hours, &c., &c.

It is obvious that the four cells noted may be charged in the same time by a dynamo of larger power than 1-2 horse.

"A water motor has a wider range of power than any steam engine. It is simply a question of the amount of water that can be provided for it. With the same Pelton Wheel I have got 16 horse power at an efficiency of 86 per cent., and 3-4 horse power at 82 per cent. efficiency. Where is there a steam engine that can equal that performance? This same motor is capable of developing at least 60 horse power at the same high efficiency."

Signed, LIEUT. F. J. HAESELER, U. S. N.

NOTE.—When supplemented with the High Tension Batteries the acme of cheap power for transmission is reached. (See Prof. Rowland's Report of 97 per cent. efficiency.



Shipping Front of the High Tension Electric Storage Company.